#16/Appeal Brief 11/21/3

PATENT
39943/PAN/C715

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Choquette et al. Group No.: 2815

Serial No.: 09/ 871,492 Examiner: Warren, M.

Filed: May 31, 2001

For: Long Wavelength Vertical Cavity Laser

APPELLANT'S BRIEF (37 C.F.R. 1.192)

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This brief is in furtherance of the Notice of Appeal, filed in this case on September 17, 2003.

The fees required under § 1.17(c), and any required petition for extension of time for filing this brief and fees therefor, are dealt with in the accompanying TRANSMITTAL OF APPEAL BRIEF.

This brief is transmitted in triplicate. (37 CFR 1.192(a))

Respectfully submitted,

11/05/2003 SDENBOB1 00000099 190131 09871492
01 FC:1402 330.00 DA

10/28/03
John P. Hohimer
Attorney for Appellants
Reg. No. 39,226
Ph: (505) 844-4007

CERTIFICATE OF MAILING

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited on the date shown below with the United States Postal Service in an envelope addressed to the Assistant Commissioner for Patents, Washington, D. C. 20231.

[X] 37 CFR 1.8(a)
With sufficient postage as first class mail

OR

[ ] 37 CFR 1.10
As "Express Mail Post Office to Addressee"
Mailing Label No. _____

MARY LOUKOTA
(Type or print name of person mailing paper)

Dated: 10/29/03

Mary Loukota
(Signature of person mailing paper)

I REAL PARTY IN INTEREST (37 C.F.R. 1.192(c)(1))

The real party in interest in this appeal is:

___ the party named in the caption of this brief.

_X_ the following party: Sandia Corporation.

II RELATED APPEALS AND INTERFERENCES (37 C.F.R. 1.192(c)(2))

With respect to other appeals or interferences that will directly affect, or be directly affected by, or have a bearing on the Board's decision in this appeal:

_X_ There are no such appeals or interferences.

___ These are as follows:

III STATUS OF CLAIMS (37 C.F.R. 1.192(c)(3))

The status of the claims in this application are:

Claims 1-9, 11-18 and 20-23 are pending in the application.

Claims 1-23 have been rejected in a Final Rejection dated May 29, 2003.

Claims 10 and 19 were cancelled in an Amendment and Response to the Final Rejection; and Claims 1-9, 11-18 and 20-23 are being appealed herein.

A. TOTAL NUMBER OF CLAIMS IN APPLICATION

Claims in the application are: Claims 1 - 23

B. STATUS OF ALL THE CLAIMS

1. Claims cancelled: 10 and 19
2. Claims withdrawn from consideration but not cancelled: None
3. Claims pending: Claims 1-9, 11-18 and 20-23
4. Claims allowed: None
5. Claims rejected: Claims 1-23

C. CLAIMS ON APPEAL

The claims on appeal are: Claims 1-9, 11-18 and 20-23

IV STATUS OF AMENDMENTS (37 C.F.R. 1.192(c)(4))

An Amendment and Response to Final Office Action was submitted to the Office on July 15, 2003 after the Final Rejection dated May 29, 2003 cancelling Claims 10 and 19, and amending Claims 1, 5-9 and 11-13. An Advisory Action was mailed on August 20, 2003 maintaining the rejection of Claims 1-23, but entering the amendments presented in the Amendment and Response of July 15, 2003 for purposes of appeal.

V SUMMARY OF INVENTION (37 C.F.R. 1.192(c)(5))

The present invention as recited in exemplary Claim 1 and as shown by way of example in Fig. 1 is a vertical-cavity surface-emitting laser 10 (also termed a VCSEL). The VCSEL 10 comprises a semiconductor substrate 12 (see page 4, lines 19-22 and page 5, lines 22-24) whereon a plurality of semiconductor layers are epitaxially grown to form a pair of n-type mirrors 14 and 16 (see page 5, lines 5-11 and page 7, line 10 through page 8, line 33) sandwiched about an active region 18 (see page 11, line 32 through page 13, line 17) which includes one or more indium gallium arsenide nitride (InGaAsN) quantum wells 30 (see page 12, lines 6-33; page 13, lines 18-24; and page 17, lines 3-33). The n-type mirror 16 includes a tunnel junction 28 (see page 5, lines 12-19; page 13, line 25 through page 14, line 2; and page 15, line 34 through page 16, line 20) therein for injecting holes (i.e. positively charged carriers) into the active region 18, with the holes recombining with electrons (i.e. negatively charged carriers) to generate lasing action and the emission of light at a nominal wavelength of 1300 nanometers (nm).

VI ISSUES (37 C.F.R. 1.192(c)(6))

A. Whether Claims 1-9, 11-18 and 20-23 are unpatentable under 35 U.S.C. § 103(a) in view of Lebby et al (U.S. 5,956,363) and Brillouet et al (U.S. 6,052,398).

VII GROUPING OF CLAIMS (37 C.F.R. 1.192(c)(7))

Claims 1-9, 11-18 and 20-23 stand or fall together for Issue A.

VIII ARGUMENTS - REJECTION UNDER 35 U.S.C. 103 (37 C.F.R. 1.192(c)(8)(iv))

A. Are Claims 1-9, 11-18 and 20-23 unpatentable under 35 U.S.C. § 103(a) in view of Lebby et al (U.S. 5,956,363) and Brillouet et al (U.S. 6,052,398)?

To establish a *prima facie* case of obviousness, the following requirements must be met:
(A) The claimed invention must be considered as a whole;
(B) The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination;
(C) The references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention; and
(D) Reasonable expectation of success is the standard with which obviousness is determined. *Hodosh v. Block Drug Co., Inc.*, 786 F.2d 1136, 1143 n.5, 229 USPQ 182, 187 n.5 (Fed. Cir. 1986).

Appellants respectfully submit that the Office has not met requirements (B) and (D) above to form a valid *prima facie* rejection of Claims 1-9, 11-18 and 20-23. The Lebby et al and Brillouet et al references are contrary so that their combination results in a nullity and cannot form the basis for a *prima facie* case of obviousness. Appellants further respectfully submit that even if Brillouet et al were to be combined with Lebby et al, the result would not be Appellants' claimed invention as recited in exemplary Claim 1. Finally, Appellants respectfully submit that the Office has not shown the requisite motivation for one skilled in the art to form Appellants' claimed invention based on these references.

(1) The references considered as a whole do not suggest the desirability and thus the obviousness of making the combination.

Brillouet et al disclose vertical-cavity surface-emitting lasers (VCSELs) formed on an InP substrate with a bottom distributed Bragg reflector (DBR) mirror 18, 118, 218, 318, or 418 being formed from the indium phosphide/indium-gallium phosphide-arsenide (InP/InGaAsP) material system (see col. 4, lines 12-30; col. 9, lines 22-26; col. 11, lines 5-10, 36-41 and 56-61). This is contrary to Lebby et al who teach against the use of InP/InGaAsP for the DBR mirrors:

> When an InGaAs/InGaAsP active region is used, an InP/InGaAsP material system must be used for the mirror stacks in order to achieve a lattice match to the InP. In this system, however, it is practically impossible to achieve decent DBR based mirrors because of the insignificant difference in the refractive indices in this material system. (col. 1, lines 43-49)

Appellants respectfully submit that the requirement in Brillouet et al for a bottom DBR mirror formed in the InP/InGaAsP material system and the teaching in Lebby et al against the use of the InP/InGaAsP material system to form such a DBR mirror results in a nullity and provides evidence for the *prima facie* unobviousness of this combination of references set forth by the Office. One skilled in the art would not be motivated to combine Brillouet et al with Lebby et al to form Appellants' claimed invention given the contrary requirements for the bottom DBR mirror in these two references. Therefore, Appellants' Claim 1 must be allowable.

Additionally, Lebby et al teaches a requirement for two DBR mirrors with opposite doping types, with one DBR mirror being n-type doped and the other mirror being p-type doped; whereas Brillouet et al teach to the contrary that both DBR mirrors must be of the same doping type (see claim 1; abstract; col. 1, lines 18-33; and col. 4, lines 19-20 and 53-56), preferably n-type doped. The requirement in Lebby et al for two DBR mirrors with opposite doping is explicitly stated in col. 5, lines 1-6:

> Doping of stack 14 and 26 of distributed Bragg reflectors is achieved by using any suitable n-type dopant and p-type dopant, respectively. However, **it should be understood that while on[e] of stacks 14 and 26 of distributed Bragg reflectors will be selected as being p-type doped, the other stack 26 and 14 will be n-type doped**. (emphasis added)

and again in col. 5, lines 14-18:

> To complete VCSEL 10, a p-contact layon mirror stancioned on mirror stack 26, and a n-contact layer 46 is positioned on substrate 12, for example on the rear surface thereof, when mirror stack 26 is p-type dope[d] and mirror stack 14 is n-type doped.

and yet again in col. 6, lines 29-34:

> Various changes and modifications to the embodiments herein chosen for purposes of illustration will readily occur to those skilled in the art. For example, **it should be understood that VCSEL structure symmetry exists for both the p and n dopants as well as electrically inverted structure designs**. (emphasis added)

The contrary requirements for doping of the two DBR mirrors in Lebby et al and Brillouet et al provides further evidence for the *prima facie* unobviousness of this combination set forth by the Office.

(2) There is no reasonable expectation of success since the combination of Lebby et al and Brillouet et al as set forth by the Office would not result in the invention recited in Appellants' Claim 1.

Appellants further respectfully submit that even if one skilled in the art were to take the tunnel junction of Brillouet et al and insert it into the VCSEL of Lebby et al as suggested by the Office in paper no. 12, this would not result in Appellants' invention as recited in Claim 1. The Office on page 3 of paper no. 12 incorrectly cites Lebby et al as showing "all of the elements of the claims except the tunnel junction included in the second mirror and the method of forming it." Lebby et al, as shown from the citations above, require the two DBR mirrors to be of opposite p-type and n-type doping type contrary to Appellants' Claim 1 so that inserting the tunnel junction of Brillouet et al into the VCSEL of Lebby et al would necessarily result in a VCSEL having one p-type doped DBR mirror and a second n-type doped DBR mirror; whereas Appellants' Claim 1 requires two n-type mirrors. Therefore, Appellants respectfully submit that there is no reasonable expectation of success for forming Appellants' invention as recited in Claim 1 by combining Lebby et al with Brillouet et al as suggested by the Office since this combination would result in a completely different VCSEL structure from that recited in Appellants' Claim 1.

(3) The Office has not shown the motivation for one skilled in the art to combine Lebby et al with Brillouet et al to form Appellants' invention as recited in Claim 1.

To form a valid *prima facie* case of obviousness, the Office must show the motivation that would lead one skilled in the art to combine the references used as the basis of the obviousness rejection. The Office cites on page 3 of paper no. 12 as motivation for one skilled in the art to combine the VCSEL structure of Lebby et al with the tunnel junction of Brillouet et al:

> Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the second mirror of the laser described in Lebby by adding tunnel junction layer as taught by Brillouet to allow the pumping current to be conducted to the active region without a substantial potential drop.

Appellants respectfully submit that one skilled in the art would not be motivated to insert a tunnel junction as disclosed by Brillouet et al into the VCSEL of Lebby et al for the reason set forth above since Lebby et al do not disclose any problem with a potential drop at all. To the contrary, it is the presence of the tunnel junction in Brillouet et al that results in a potential drop

that must be alleviated by increasing the doping of the tunnel junction to the point where the potential drop is no longer "troublesome" (see col. 5, lines 6-10). Appellants respectfully submit that the motivation cited by the Office is flawed since the use of a tunnel junction as disclosed by Brillouet et al would add to the potential drop rather than to reduce it. Therefore, one skilled in the art would avoid the use of a tunnel junction if the motivation were "to allow the pumping current to be conducted to the active region without a substantial potential drop" as suggested by the Office.

The requirement for a tunnel junction in the VCSEL of Brillouet et al is necessitated by the lack of a p-type doped DBR mirror to provide holes for injection into the active region to recombine with electrons provided by an n-type DBR mirror located on the other side of the active region. The use of a tunnel junction is required in Brillouet et al to supply these missing holes without which the VCSEL cannot operate since it is the recombination of electrons and holes in the active region that provides optical gain for lasing. The VCSEL of Lebby et al is fully functional without any disclosed concern about conduction of the pumping current into the active region since it includes a p-type mirror to provide holes into the active region, and an n-type mirror to provide electrons therein. Therefore, Appellants respectfully submit that the motivation cited by the Office "to allow the pumping current to be conducted to the active region without a substantial potential drop" would not lead one skilled in the art to insert a tunnel junction into the VCSEL of Lebby et al since no tunnel junction is needed in the structure of Lebby et al and since no advantage would be gained by doing so. To the contrary, adding the tunnel junction of Brillouet et al to the VCSEL of Lebby et al would result in some increased potential drop as compared to the fully functional VCSEL of Lebby et al without the tunnel junction so that performance would be degraded. Thus, Appellants respectfully submit that the Office has not shown the requisite motivation required for a valid *prima facie* case of obviousness based on the combination of Lebby et al and Brillouet et al. Therefore, Claim 1 is allowable.

In view of the above remarks, Appellants respectfully submit that the Office has not made a valid *prima facie* case of obviousness since the Office has not met its burden as set forth in *Hodosh v. Block Drug Co., Inc.* and other similar cases. Therefore, Appellants respectfully submit that Claim 1 is allowable.

IX APPENDIX OF CLAIMS (37 C.F.R. 1.192(c)(9))

1. (Once amended) A vertical cavity surface emitting laser comprising:

a substrate;

a first n-type mirror adjacent the substrate;

an active region including one or more quantum wells, the quantum wells being formed of InGaAsN;

a second n-type mirror adjacent the active region, the second mirror including a tunnel junction for injecting holes into the active region,

wherein the laser emits light at a nominal wavelength of 1300 nm.

2. The vertical cavity surface emitting laser of claim 1, wherein the substrate includes GaAs.

3. The vertical cavity surface emitting laser of claim 1, wherein the tunnel junction includes a n-type layer and a p-type layer.

4. The vertical cavity surface emitting laser of claim 3, wherein the p-type layer of the tunnel junction is positioned at or near a standing wave null in optical field.

5. (Once amended) The vertical cavity surface emitting laser of claim 2, further comprising one or more oxide apertures, proximate to the active region, wherein the oxide aperture includes an oxidized portion therein.

6. (Once amended) The vertical cavity surface emitting laser of claim 5 wherein the oxidized portion of the oxide aperture comprises an aluminum oxide.

7. (Once amended) The vertical cavity surface emitting laser of claim 5 wherein the oxide aperture comprises a carbon doped spike positioned at or near a standing wave null in optical field.

8. (Once amended) The vertical cavity surface emitting laser of claim 5, further comprising a mesa extending downward at least to the oxide aperture.

9. (Once amended) The vertical cavity surface emitting layer laser of claim 1 wherein the first and second n-type mirrors comprise unipolar distributed Bragg reflector mirrors.

10. (Cancelled)

11. (Once amended) The vertical cavity surface emitting laser of claim 1 further comprising an upper electrode above the second mirror stack and a lower electrode below the active region.

12. (Once amended) The vertical cavity surface emitting laser of claim 11 wherein the lower electrode includes an annular aperture therein to monitor transmitted output power of the vertical cavity surface emitting laser from light emitted through the annular aperture in the lower electrode.

13. (Once amended) A method of manufacturing a surface emitting laser that emits light at a nominal wavelength of 1300 nm., comprising:
forming a first n-type mirror on a substrate;
forming an active region having one or more InGaAsN quantum wells on the substrate;
forming a current constriction proximate the active region;
forming a second n-type mirror above the active region; and
forming a tunnel junction in the second n-type mirror, wherein the tunnel junction comprises an n-type region and a p-type region and the p-type region is positioned at or near a standing wave null in optical field.

14. The method of claim 13 wherein the step of forming a current constriction comprises forming oxide aperture layers proximate to said active region.

15. The method of claim 14 wherein the step of forming oxide aperture layers proximate to said active region comprises forming at least one aluminum alloy layer proximate to said active region.

16. The method of claim 15 further comprising forming a mesa downward from upper most surface of the surface emitting laser to the oxide aperture layers and oxidizing an annular portion of said oxide aperture layers.

17. The method of claim 15 wherein the step of forming oxide aperture layers further comprises doping each aluminum alloy layer with an n-type or p-type dopant.

18. The method of claim 17 wherein the step of doping the aluminum alloy layer with the p-type dopant further comprises forming a carbon doped spike in said aluminum alloy layer, wherein said carbon doped spike is positioned at or near a standing wave null in the optical field.

19. (Cancelled)

20. The method of claim 13 wherein the step of forming said second mirror comprises forming one or more pairs of semiconductor mirror layers, wherein one layer in each pair has an index of refraction that is different from the index of refraction of the other layer in each pair.

21. The method of claim 20 wherein the step of forming said semiconductor mirror layers comprises forming one quarter wavelength thick alternating layers of AlGaAs and GaAs, wherein said tunnel junction is formed into the GaAs layer nearest said active region.

22. The method of claim 13 further comprising forming an upper electrode above the second mirror and forming a lower electrode below the active region.

23. The method of claim 22 wherein the steps of forming the upper and lower electrodes comprises forming at least one of the upper and lower electrodes having an annular aperture therein.